IB/105/050884

PA 1281568

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February 09, 2005

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APPLICATION NUMBER: *60/558,279*
FILING DATE: *March 31, 2004*

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

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Certifying Officer

PTO/SB/16 (10-01)
Approved for use through10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No.	ER556413103US

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☑ *Additional inventors are being named on the* 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

METHOD FOR POSITIONING OF WIRELESS MEDICAL DEVICES WITH SHORT-RANGE RF TECHNOLOGY

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 8 ☐ CD(s), Number

☐ Drawing(s) *Number of Sheets* ☐ Other (specify)

☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees

☑ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 14-1270

☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($): $160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE Tom Lundin

Date 03/31/2004

TYPED or PRINTED NAME Thomas M. Lundin, Esq.

REGISTRATION NO. *(if appropriate)* 48,979

Docket Number: PHUS040172USQ

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USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

PROVISIONAL APPLICATION COVER SHEET
Additional Page

PTO/SB/16 (02-01)
Approved for use through 10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Docket Number	PHUS040172USQ

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Number 1 of 1

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METHOD FOR POSITIONING OF WIRELESS MEDICAL DEVICES WITH SHORT-RANGE RF TECHNOLOGY.

The invention comprises a method for automatic localization of wireless medical devices based on derived position information.
The invention makes it possible, that local wireless devices, which are not directly attached to the hospital wireless network, but only have a short-range wireless interface, can be located with the support of other mobile wireless devices being attached to the wireless infrastructure.
Positioning is performed by exploitation of RF information of the local wireless medical devices, that is gathered by mobile wireless devices, which themselves are being tracked by an overall RF positioning system.
This way, also those devices can be located, that are not visible by a positioning system that is based on the overall RF infrastructure.

Advantages
- positioning of wireless medical devices with short-range connectivity
- localization of patients, finding of devices
- no additional positioning hardware required; exploits available RF infrastructure
- only one overall hospital-wide positioning system required
- co-operation with any installed overall positioning system for wireless WLAN devices

Application Area
Our solution can be applied everywhere in all hospital application areas that deploy wireless devices with local connectivity. The solution is especially suitable in the wireless monitoring / telemetry area, where a complete wireless infrastructure is already available. The invention allows localization of devices that would otherwise not be visible for an RF-based positioning system.

The invention comprises a method for automatic localization of wireless medical devices based on derived position information.
The invention enables localization of local wireless devices, which are not directly attached to the hospital wireless network, but only have a short-range wireless interface. This is achieved with the support of other mobile wireless devices being attached to the wireless infrastructure.
Positioning is performed by exploitation of RF information of the local wireless medical devices, that is gathered by mobile wireless devices, which themselves are being tracked by an overall RF-based positioning system.

This way, also those devices can be located, that are not visible by a positioning system that is based on the overall RF infrastructure.

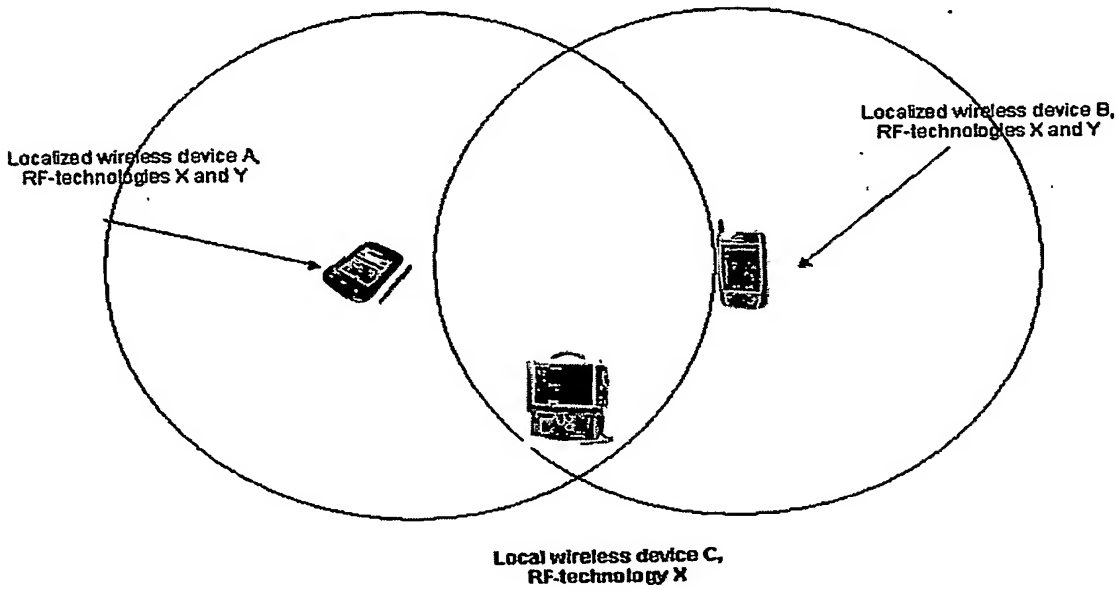

Figure 1: RF-'visibility' of local, short-range wireless device C by localized wireless devices A and B

Application Area
Medical (monitoring) devices are increasingly being equipped with wireless connectivity, in order to (remotely) control and configure these devices, as well as to continuously transmit vital signs of patients. Frequently, different RF technology are being deployed in hospitals – on the one hand for long-range connectivity to ward- or hospital infrastructure, on the other hand for connectivity of small local devices, e.g. in the patient room.

This also raises the need for localizing wireless devices (long-range as well as short-range), e.g. for localizing patients or finding medical devices.

Our positioning solution can be applied in application areas (e.g. hospitals) that deploy wireless devices with local connectivity in addition to an overall wireless infrastructure. The solution is suitable in the wireless monitoring / telemetry area, where a wireless infrastructure is already available.

The invention allows localization of devices that would otherwise not be visible for an RF-based positioning system.

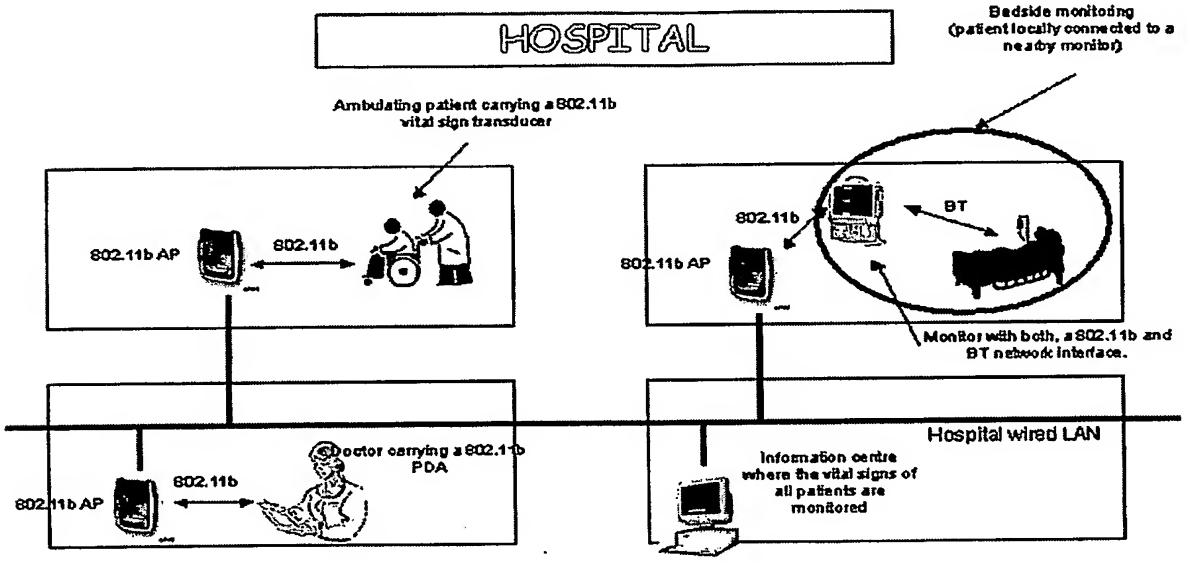

Figure 2: Example of a hospital network infrastructure with different RF technologies

State of the art:

Calculation of the wireless device position by exploiting its RF signals is a good solution, as such systems can work without additional hardware infrastructure for positioning only. Other approaches (e.g. [4]) require additional devices (e.g. infrared-tags).

RF-based positioning systems work as follows:

- The whole area is covered by an RF infrastructure (usually based on IEEE 802.11 technology)

- Based on measurements of signal strength, signal run-time, signal direction, etc. between fixed basestations and the mobile devices, the position of an individual mobile device is being calculated.

Such systems are being described in the literature ([1],[3]), and are also available as products. ([2], [5], [6]).

The subject of our invention - systems that work dynamically, and use mobile devices (being localized themselves) as a reference for positioning of further mobile devices (with different RF technology) – is new and not covered by today's approaches.

Our solution concept:

RF systems with local, short-range (ad-hoc) connectivity (e.g. Bluetooth IEEE 802.15.1) are increasingly deployed for medical devices – in addition to the overall long-range wireless infrastructure. (*these devices will be called **LWD** – local wireless device now*)

RF-based positioning systems that are usually based on the long-range wireless infrastructure technology (i.e. wireless LAN infrastructure) can localize wireless devices with the same RF technology. But they cannot localize these LWDs, as they have a different RF-technology.

Therefore, we derive the position of the LWDs indirectly via other mobile devices. These mobile wireless devices, which are connected to the overall wireless infrastructure, can be localized with an existing RF positioning system (*these mobile devices will be called **TWD** – tracked wireless device now*).

Each TWD that is additionally equipped with local RF-connectivity (in order to connect temporarily to LWDs at certain locations) regularly retrieves information about all LWDs being in coverage of its local RF technology. The corresponding information being gathered by all TWDs is being associated and combined by our system. This allows to dynamically deriving the positions of all LWDs being in coverage of any TWD.

Advantages

- positioning of wireless medical devices with short-range connectivity
- supports various short-range connectivity systems in parallel
- localization of patients, finding of devices
- no additional positioning hardware required; exploits available RF infrastructure
- only one overall hospital-wide positioning system required
- co-operation with any installed overall positioning system for wireless WLAN devices

Technical measures:

The position of local wireless devices (LWD) is derived indirectly via mobile devices: These mobile wireless devices (TWD) are connected to the wireless infrastructure and have an additional RF interface to a local RF technology. (there may be different local RF technologies available. Each TWD has an additional RF interface to one of these RF technologies). TWD devices are being positioned via a state-of-the art RF positioning technology. Additionally, each TWD gathers RF information about the LWDs being in it's coverage (i.e. in coverage of the local RF technology being used in the individual TWD). This is performed by the DPM (derived position manager) – client.

All information being dynamically provided by the TWDs is being processed by an overall DPM-server. Based on that, the DPM derives positions of all LWDs being 'sighted' by one or several TWDs.

Algorithms of DPM client and server are detailed in the Appendix.

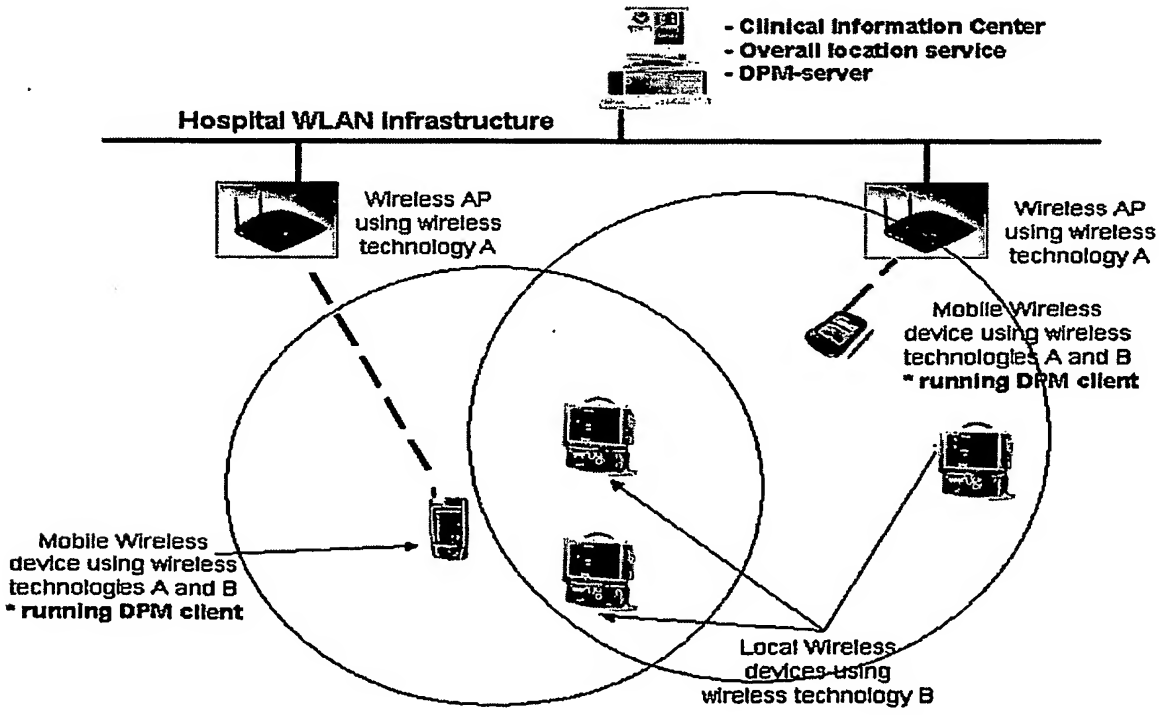

Figure 3: Overall system (deployed in a hospital)

References

[1] Jeffrey Hightower and Gaetano Borriello. "Location systems for ubiquitous computing". *IEEE Computer*, 34(8): 57-66, August 2001.

[2] Ekahau. Website, 2004. http://www.ekahau.com/

[3] Paramvir Bahl and Venkata N. Padmanabhan. "RADAR: An in-building RF-based user location and tracking system". *In Proceeding of IEEE INFOCOM*, volume 2, pages 775-784, March 2000.

[4] Roy Want, Andy Hopper, Veronica Falcao and Jon Gibbons. "The active badge location system". *ACM Transactions on Information Systems*, 10(1):91-102, January 1992.

[5] Radianse Wireless Indoor Location Solutions. Website, 2004. http://www.radianse.com/products.htm

[6] Elpas. Eiris Local Positioning System. Website, 2004. http://www.visonictech.com/info_page.asp?info_id=416/

[7] Ubisense – UWB positioning. http://www.ubisense.net/technology/

Appendix: Derived position manager

The system comprises wireless devices connected to the overall wireless network (typically a WLAN). These devices are continuously tracked by a RF-based positioning system; thus they are named TWD – Tracked Wireless Devices. Furthermore, Local wireless devices (LWD) are locally connected via short-range wireless connectivity.

The following figure shows all tasks DPM performs to determine the position of any LWD:

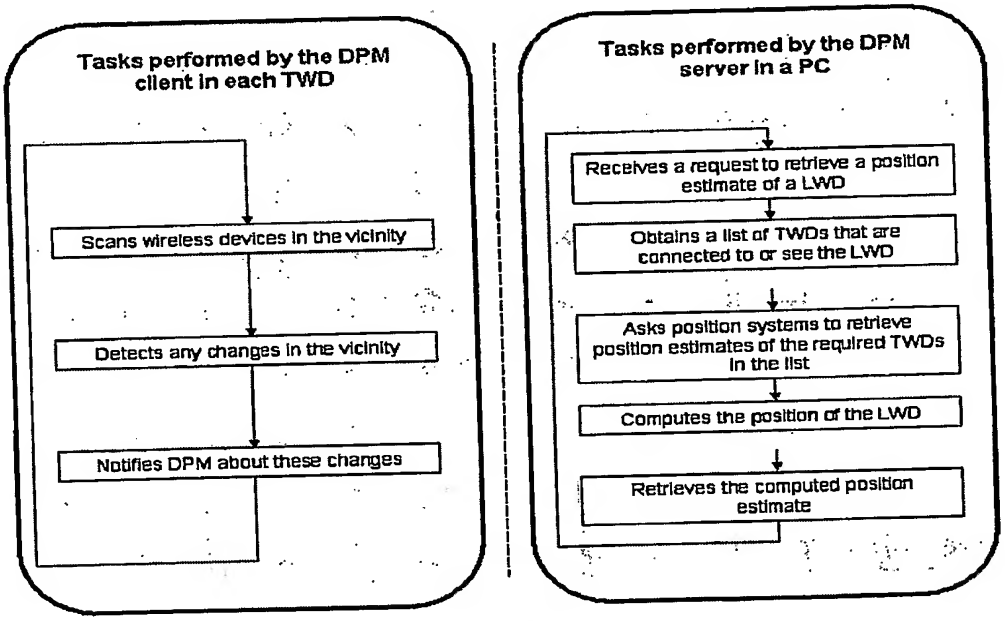

Figure 4: List of main tasks performed by DPM.

Each TWD runs a DPM client, which periodically performs all tasks listed in the left box of the above figure:

- **scanning wireless devices in the vicinity:** this means detecting which wireless devices are in the proximity of the TWD. Each time a new wireless device is detected, some device information can be obtained. DPM basically uses the following information:
  - The MAC address of the detected wireless device.
  - Status information on the detected wireless device: is the detected wireless device connected to or just seen by the TWD?
- **detecting any changes in the vicinity:** Once the scanning has been performed, the TWD is able to detect if any change has occurred in its vicinity. The following changes might occur:
  - A new wireless device comes in proximity of the TWD.

- A wireless device leaves the vicinity of the TWD.
- The status of a wireless device changes, that is, a wireless device that was previously seen by the TWD, now is also connected to it or vice versa, a wireless device that was previously connected to the TWD, now is just seen by it.

- **notifying DPM about these changes:** Anytime a change occurs in the vicinity of the TWD, DPM needs to be notified so that it always works with updated information on TWDs and their vicinities.

The central DPM server performs the tasks being listed in the right box of the figure 1:

- **receiving requests to retrieve position estimates of LWDs:** DPM is initiated by an overall location system.
- **obtaining a list of TWDs that are connected to or see the device:** When requested for the position of a certain LWD, the first thing DPM does is to check which TWDs see or are connected to the requested LWD. To do so, it uses the information obtained from all TWDs running the DPM client.
- **asking positioning systems to retrieve position estimates of those required TWDs in the list:** Once the list of TWDs is obtained, DPM checks if any TWD is connected to the requested LWD. If so, it asks the corresponding positioning system to retrieve the last position estimate of this TWD. Otherwise, it asks the corresponding positioning systems to retrieve the last position estimate of all TWDs in the list.
- **computing the position of the device:** Now DPM knows which TWDs see or are connected to the requested LWD and also where they are. The position of the requested LWD is calculated by a lateration mechanism, based on the RF information all TWDs that see the requested LWD, and their own current position. If a LWD is connceted to a TWD, the position calculation is optimized: Due to the well-defined medical application area, it is a valid assumption that a connected short-range wireless devices (LWD) is almost at the same position as the corresponding TWD; thus this TWD position is directly associated to the LWD.
- **retrieving the computed position estimate:** The calculated position estimate is provided to the overall location service.

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